Fig. 1

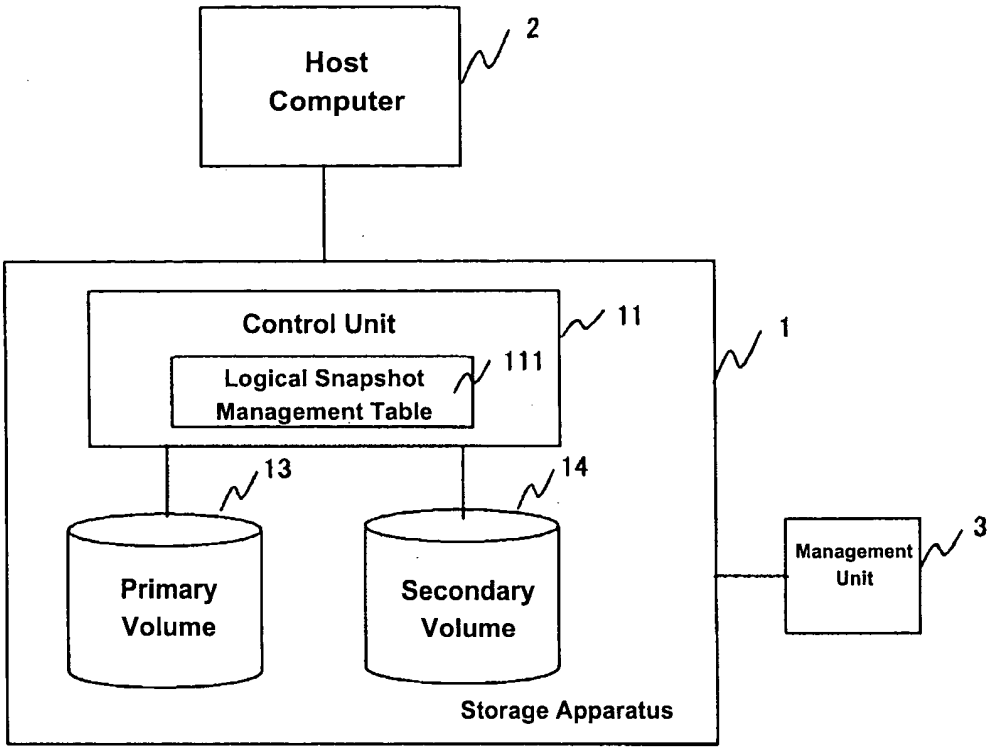

Host Computer
2
Control Unit
11
Logical Snapshot Management Table
111
1
13
14
Primary Volume
Secondary Volume
Management Unit
3
Storage Apparatus

Fig. 2

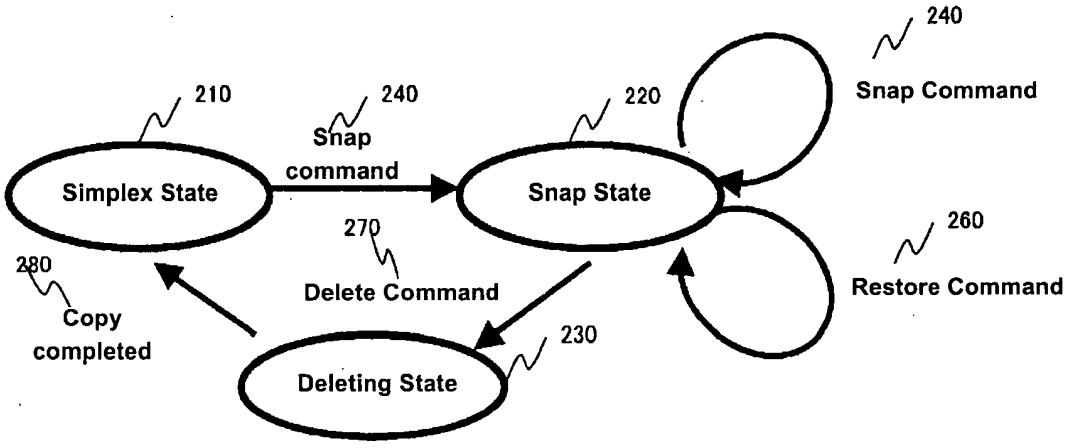

240
Snap Command
210
240
Snap command
220
Simplex State
Snap State
270
Delete Command
260
Restore Command
280
Copy completed
230
Deleting State

Fig. 3

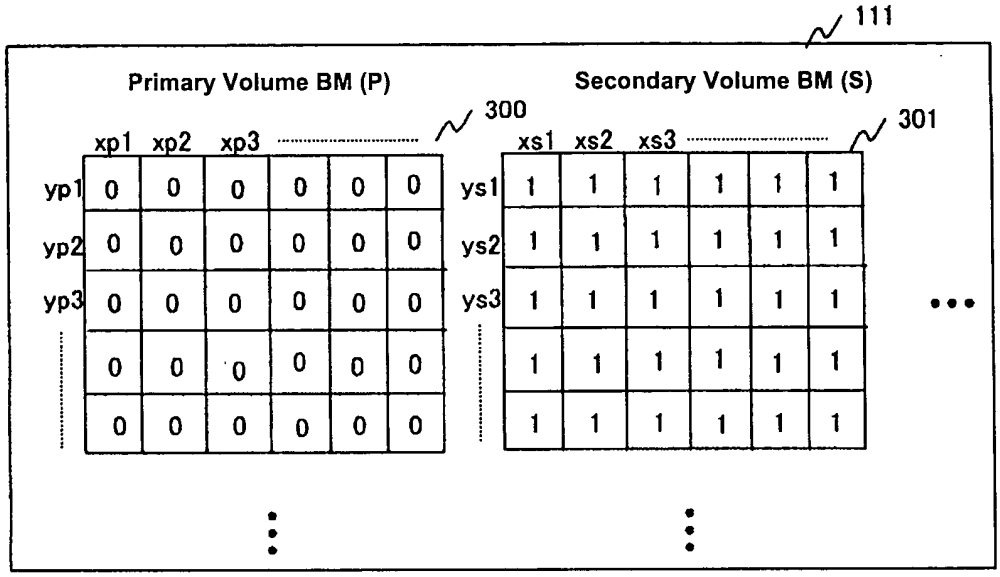

111
Primary Volume BM (P)
Secondary Volume BM (S)
300
301
xp1 xp2 xp3
xs1 xs2 xs3
yp1
yp2
yp3
ys1
ys2
ys3

Fig. 4

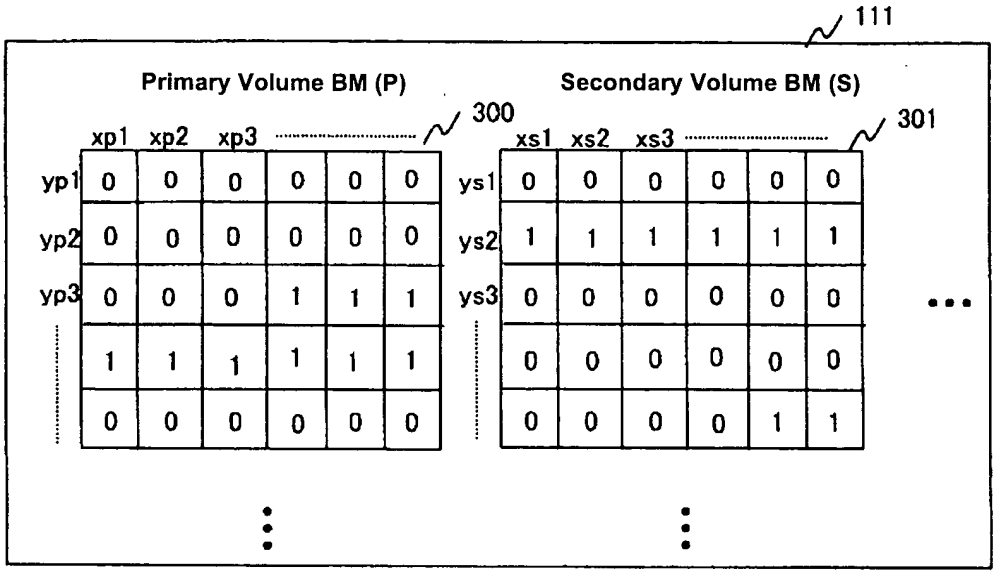


Fig. 5

State before Execution BM (P, S)	Access to Primary Volume		Access to Secondary Volume	
	Read	Write	Read	Write
(0, 0)	(0, 0)	(0, 0)	(0, 0)	(0, 0)
(0, 1)	(0, 1)	(0, 0)	(0, 0)	(0, 0)
(1, 0)	(0, 0)	(0, 0)	(1, 0)	(0, 0)
(1, 1)	N/A			

Fig. 6

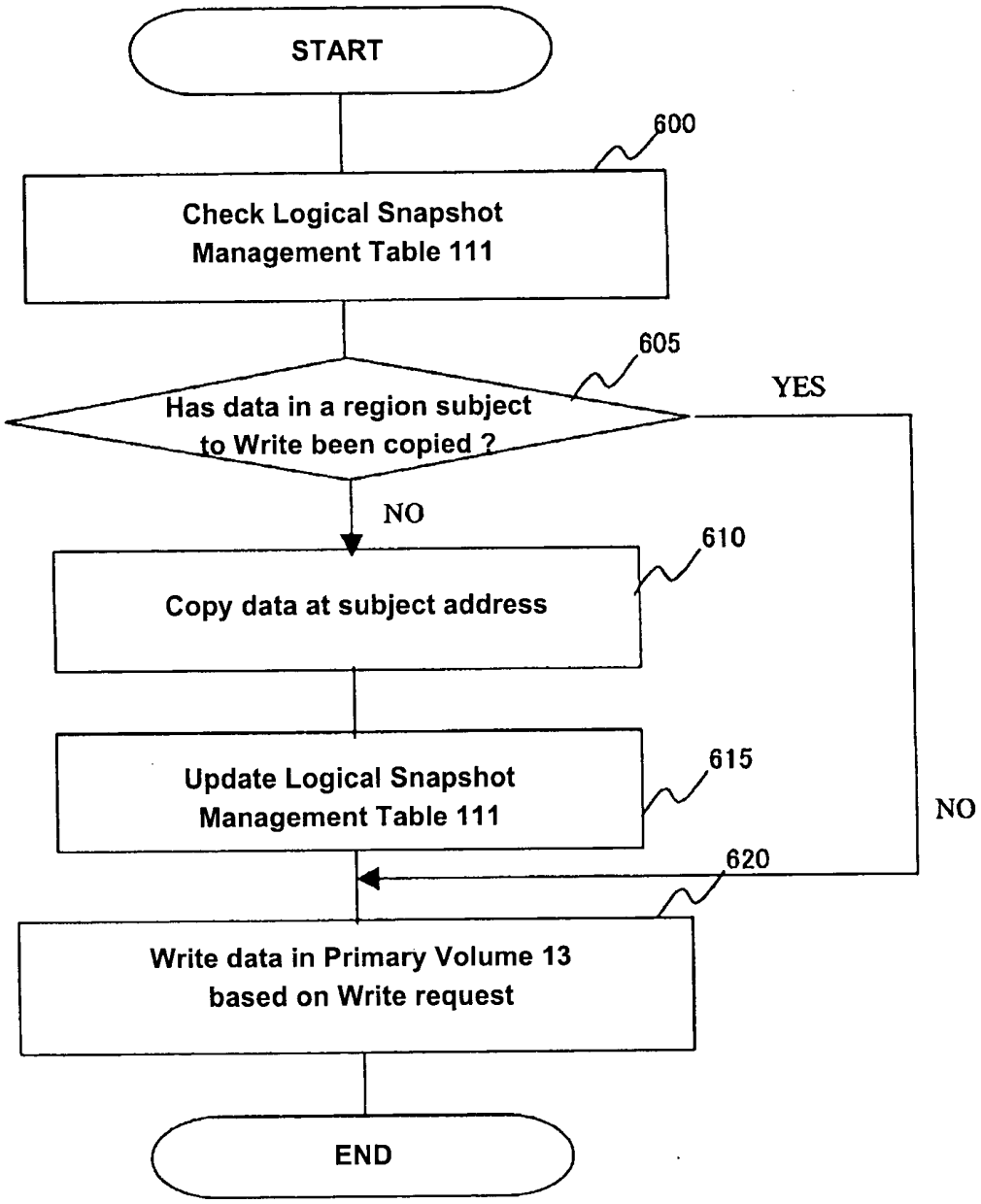

START
600
Check Logical Snapshot Management Table 111
605
Has data in a region subject to Write been copied ?
YES
NO
610
Copy data at subject address
615
Update Logical Snapshot Management Table 111
NO
620
Write data in Primary Volume 13 based on Write request
END

Fig. 7

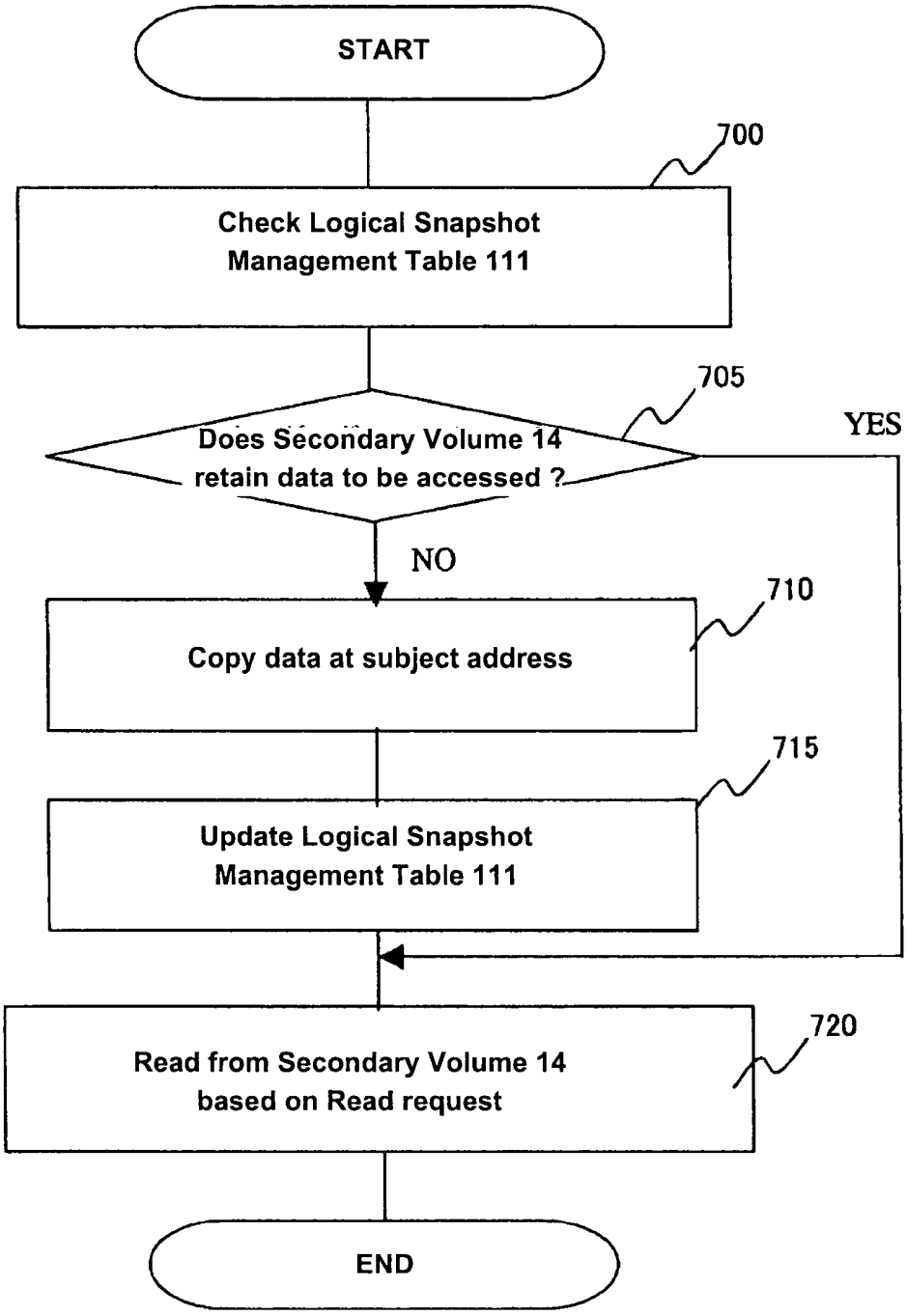

START
700
Check Logical Snapshot Management Table 111
705
Does Secondary Volume 14 retain data to be accessed ?
YES
NO
710
Copy data at subject address
715
Update Logical Snapshot Management Table 111
720
Read from Secondary Volume 14 based on Read request
END

Fig. 8

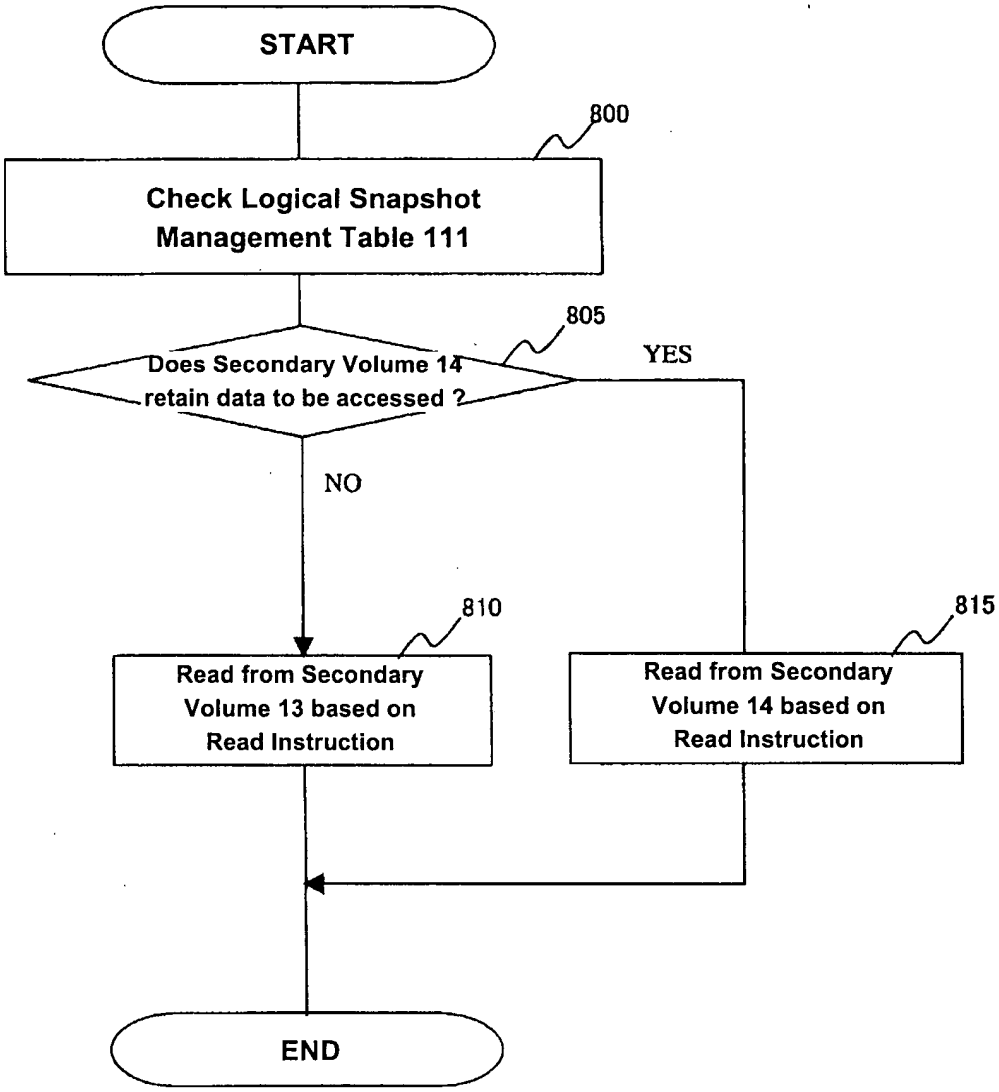

START
800
Check Logical Snapshot Management Table 111
805
Does Secondary Volume 14 retain data to be accessed ?
YES
NO
810
Read from Secondary Volume 13 based on Read Instruction
815
Read from Secondary Volume 14 based on Read Instruction
END

Fig. 9

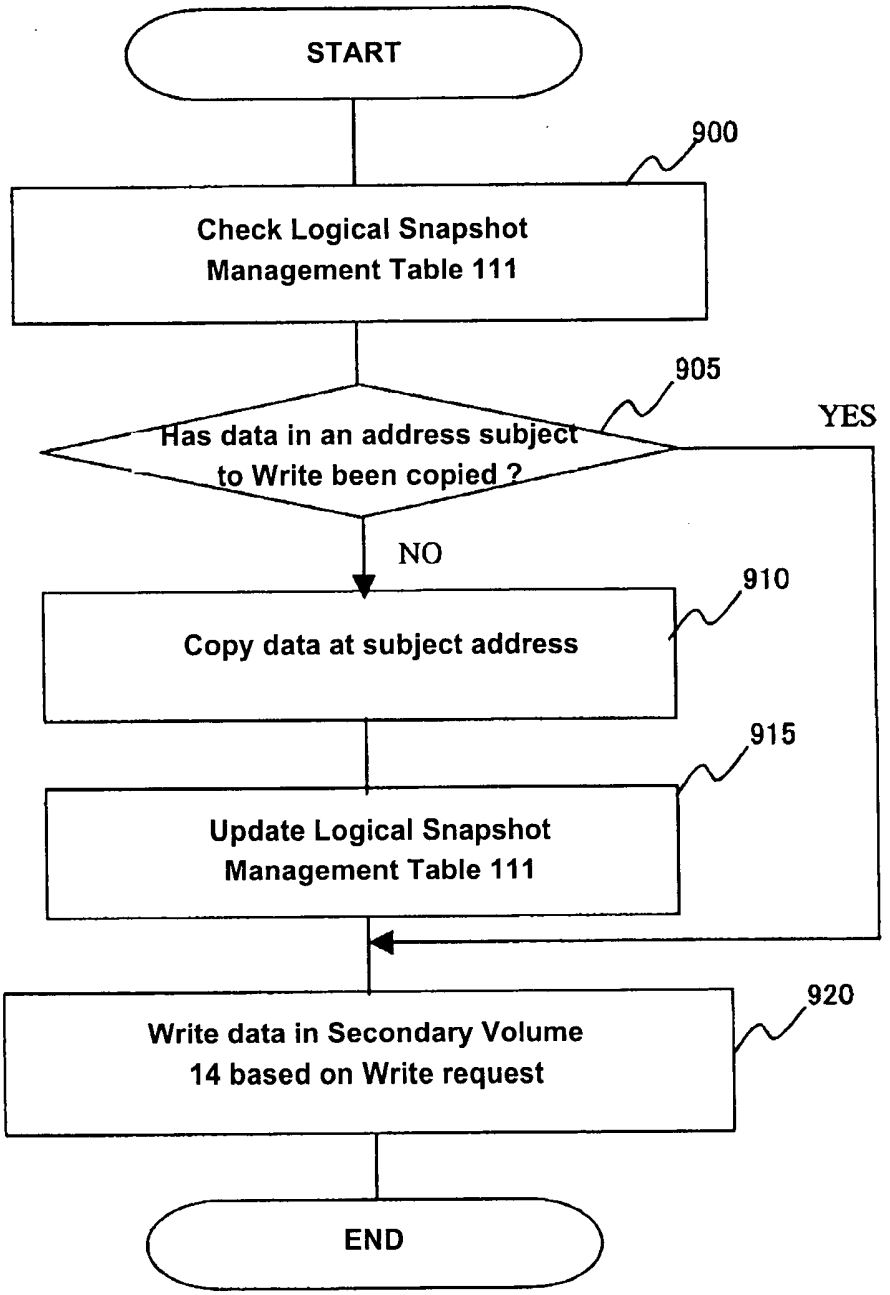

START
900
Check Logical Snapshot Management Table 111
905
Has data in an address subject to Write been copied ?
YES
NO
910
Copy data at subject address
915
Update Logical Snapshot Management Table 111
920
Write data in Secondary Volume 14 based on Write request
END

Fig. 10

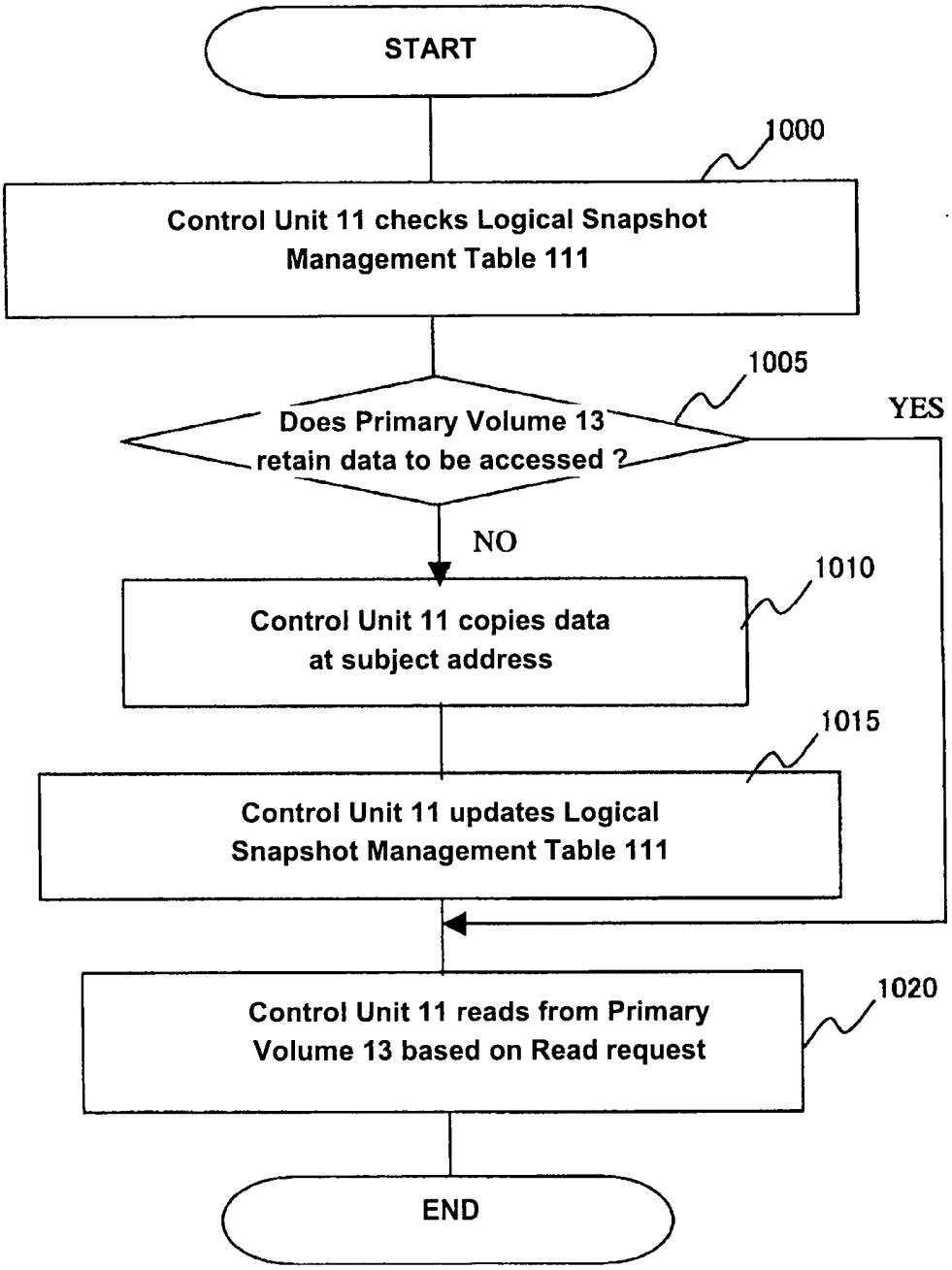

START
1000
Control Unit 11 checks Logical Snapshot Management Table 111
1005
Does Primary Volume 13 retain data to be accessed ?
YES
NO
1010
Control Unit 11 copies data at subject address
1015
Control Unit 11 updates Logical Snapshot Management Table 111
1020
Control Unit 11 reads from Primary Volume 13 based on Read request
END

Fig. 11

State before Execution (P, S)	State after receiving Snap command	State after receiving Restore command
(0, 0)	(0, 1)	(1, 0)
(0, 1)	(0, 1)	(0, 1)
(1, 0)	(1, 0)	(1, 0)
(1, 1)	N/A	

Fig. 12

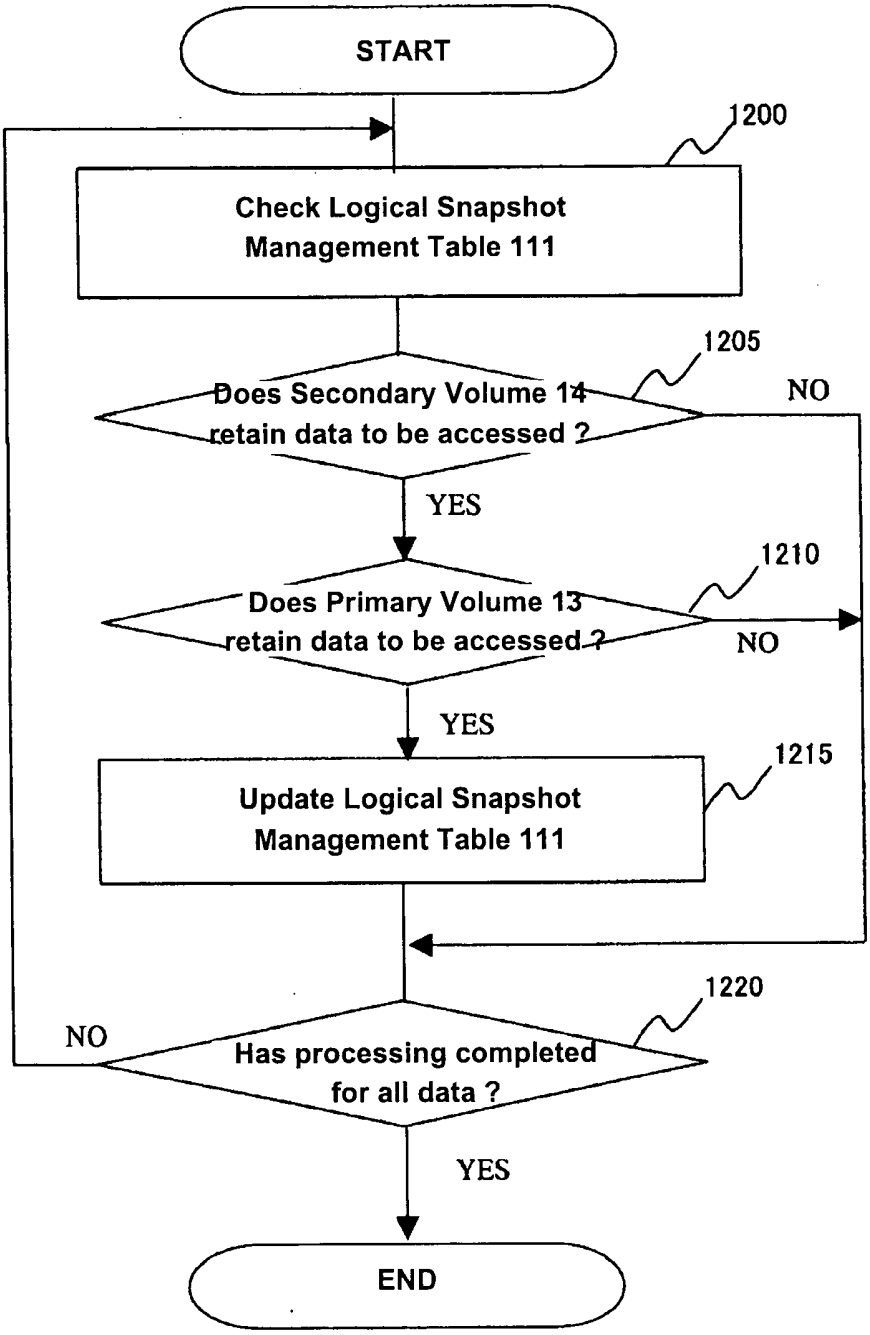

START
1200
Check Logical Snapshot Management Table 111
1205
Does Secondary Volume 14 retain data to be accessed ?
NO
YES
1210
Does Primary Volume 13 retain data to be accessed ?
NO
YES
1215
Update Logical Snapshot Management Table 111
1220
NO
Has processing completed for all data ?
YES
END

Fig. 13

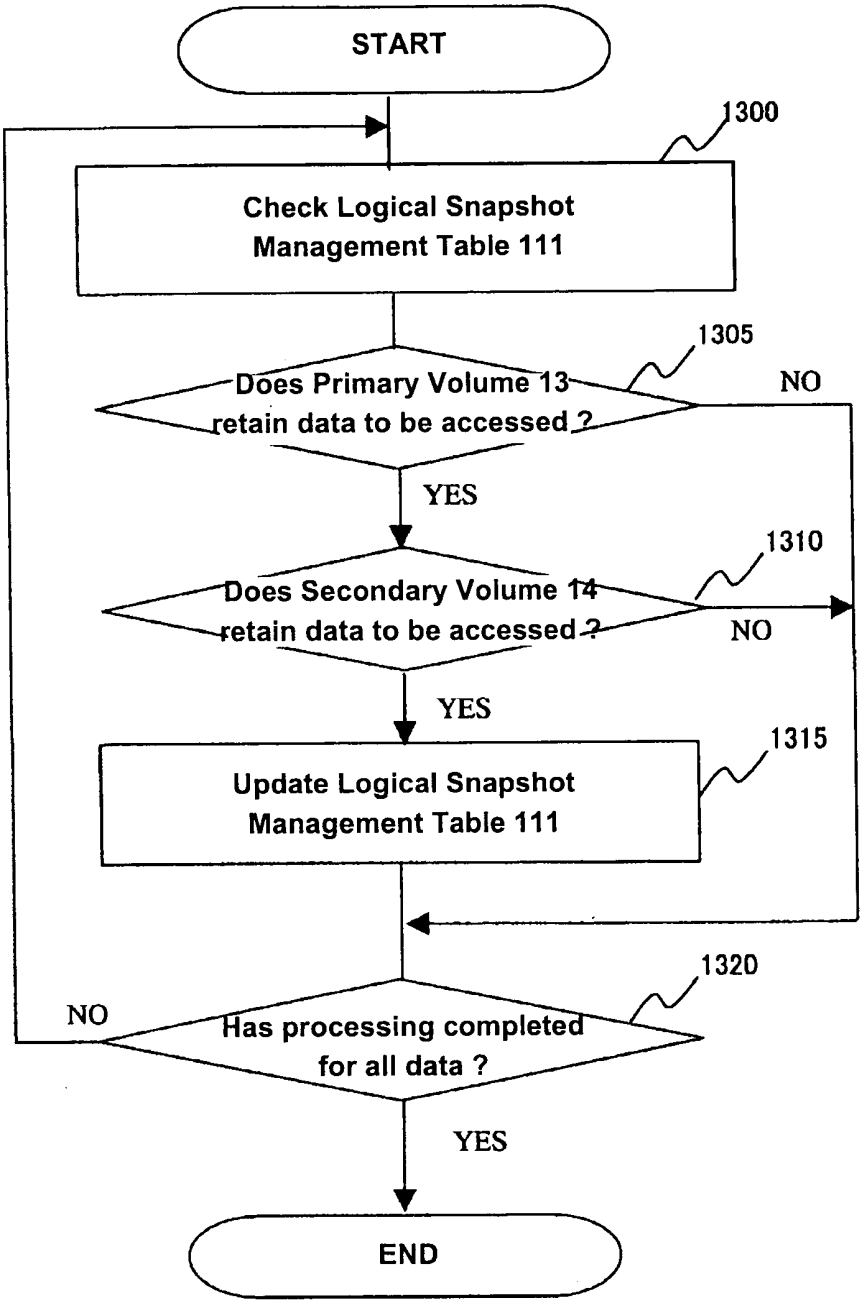

START
1300
Check Logical Snapshot Management Table 111
1305
Does Primary Volume 13 retain data to be accessed ?
NO
YES
1310
Does Secondary Volume 14 retain data to be accessed ?
NO
YES
1315
Update Logical Snapshot Management Table 111
1320
NO
Has processing completed for all data ?
YES
END

Fig. 14

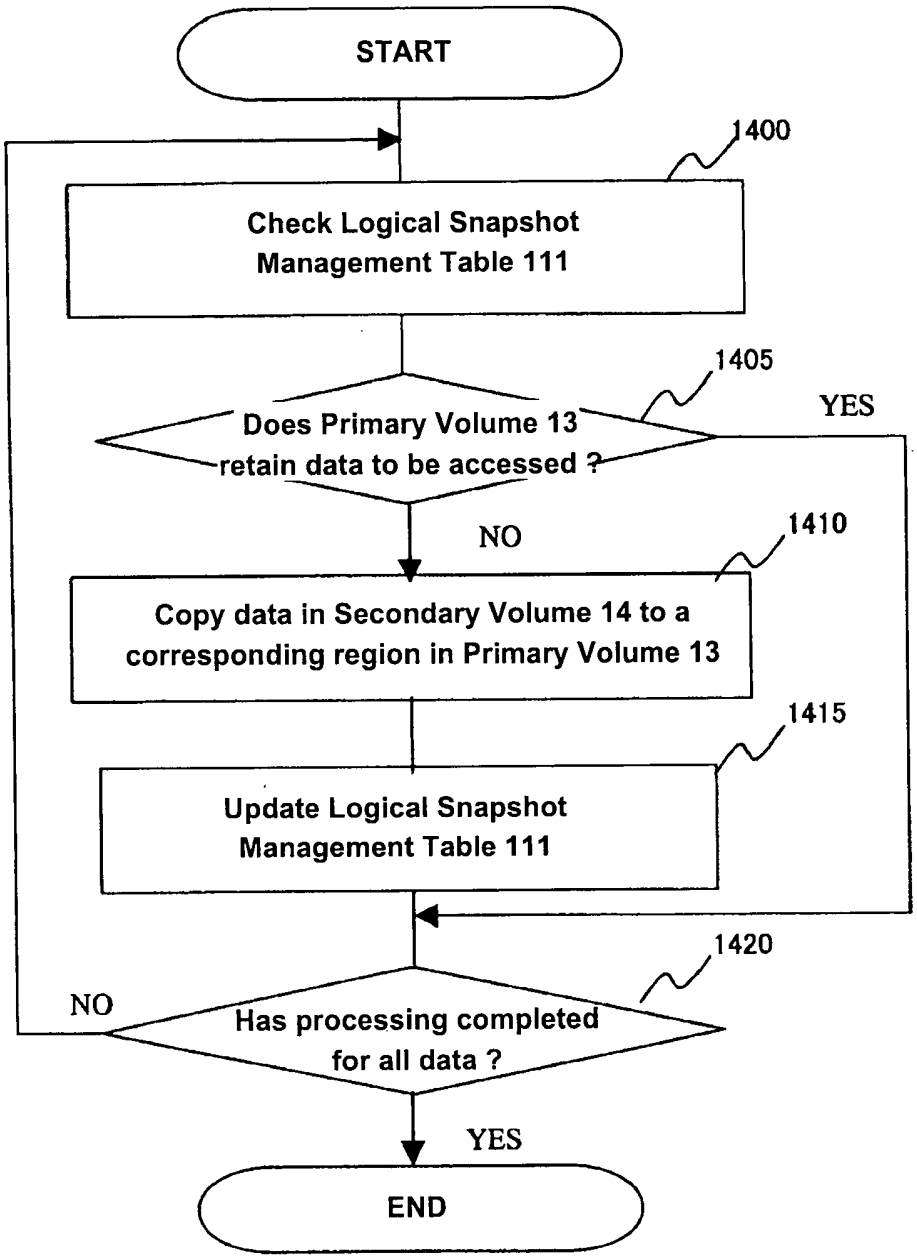

START
1400
Check Logical Snapshot Management Table 111
1405
Does Primary Volume 13 retain data to be accessed ?
YES
NO
1410
Copy data in Secondary Volume 14 to a corresponding region in Primary Volume 13
1415
Update Logical Snapshot Management Table 111
1420
NO
Has processing completed for all data ?
YES
END

Fig. 15

State before Execution (P, S)	State after receiving Delete command
(0, 0)	(0, 0)
(0, 1)	(0, 1)
(1, 0)	(1, 0)
(1, 1)	N/A

Fig. 16

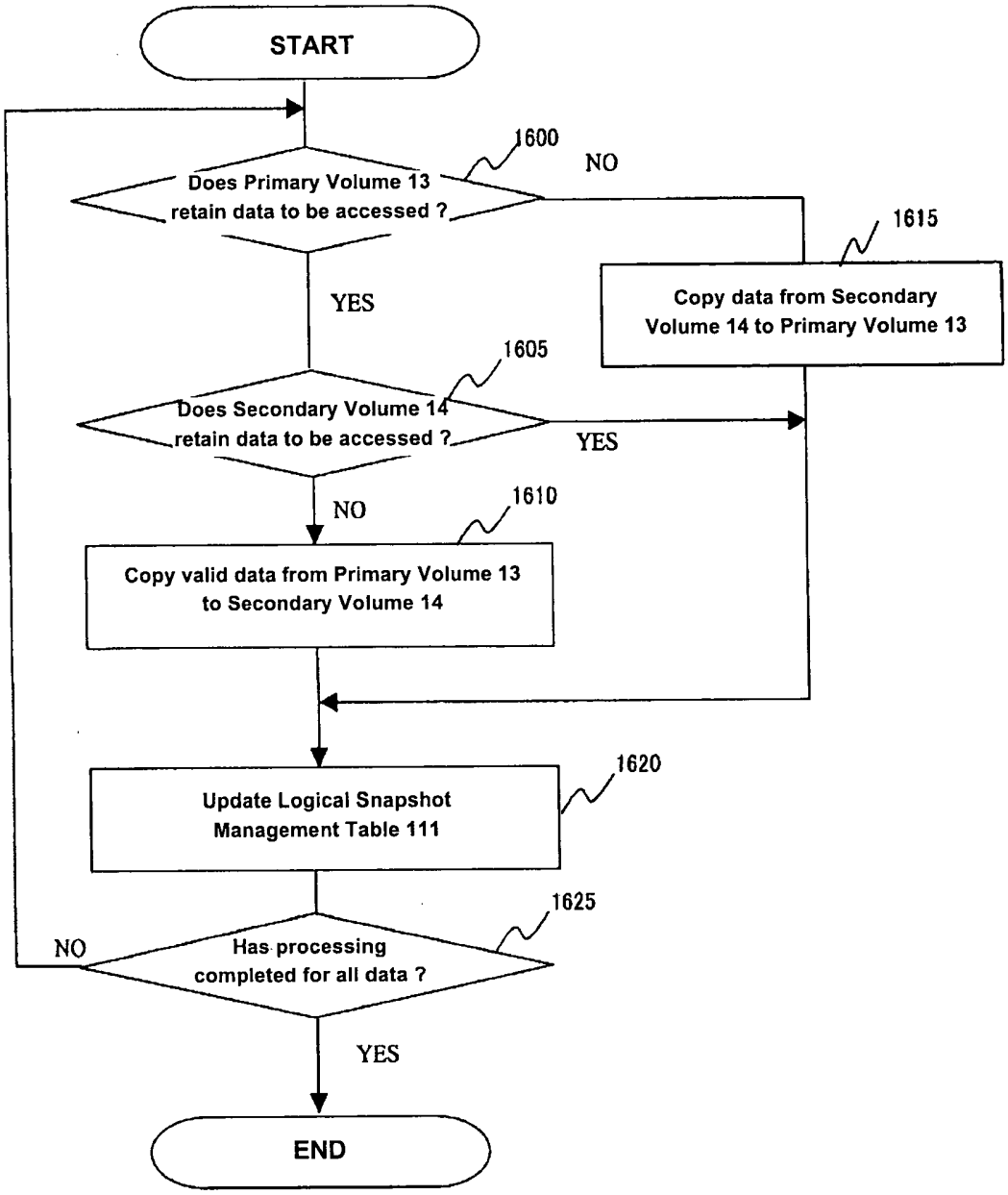

START
1600
Does Primary Volume 13 retain data to be accessed ?
NO
YES
1615
Copy data from Secondary Volume 14 to Primary Volume 13
1605
Does Secondary Volume 14 retain data to be accessed ?
YES
NO
1610
Copy valid data from Primary Volume 13 to Secondary Volume 14
1620
Update Logical Snapshot Management Table 111
1625
Has processing completed for all data ?
NO
YES
END

Fig. 17

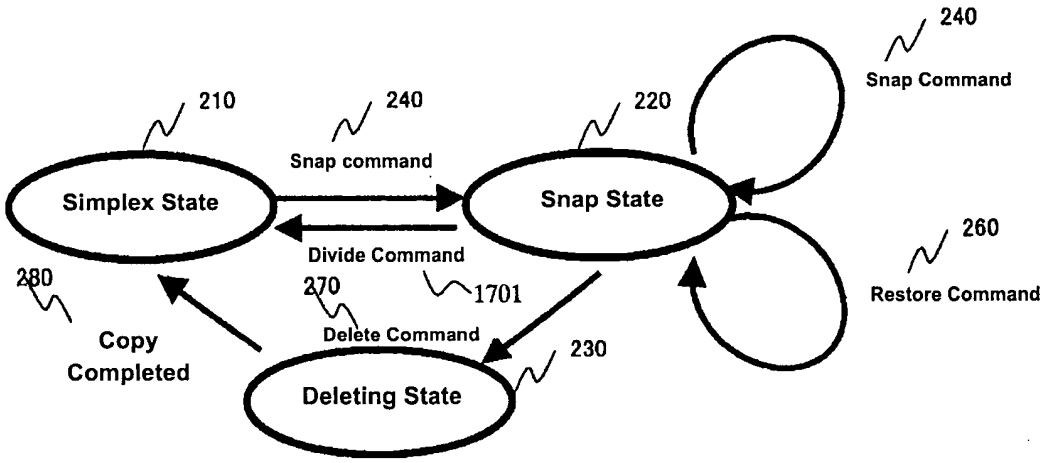
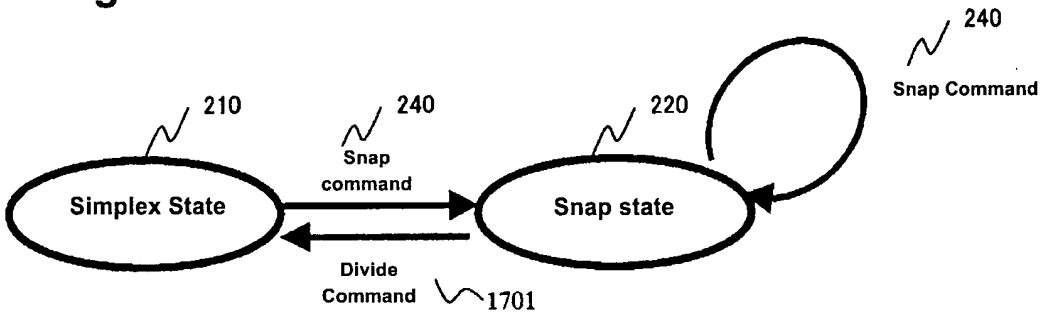

240
Snap Command
210
240
220
Snap command
Simplex State
Snap State
Divide Command
260
Restore Command
280
270
1701
Copy
Completed
Delete Command
230
Deleting State

Fig. 18


240
Snap Command
210
240
220
Snap
command
Simplex State
Snap state
Divide
Command
1701